Patent Claims

1. Process for introducing an optical cable, consisting of a tube and optical waveguides introduced therein, into solid ground with the aid of a laying unit, characterized in that the optical cable laid is a microcable or minicable (1) with an external diameter of the tube (8) of 2.0 to 10 mm, preferably of 3.5 to 5.5 mm, the tube (a) being homogeneous and pressurized-water-tight, in that the laying channel (19) with a width of 4.5 to 12 mm, preferably 7 mm, which is adapted to the diameter of the microcable or minicable (1) being made in the fixed underlying laying surface (17) using the laying unit (23), in that the microcable or minicable (1) is introduced into the laying channel (19) by means of a feed element and is held at a constant laying depth, in that the laying channel (19) is filled with filling material (20) with a filling device (16) which is moved on to the insertion of the microcable or minicable (1).

2. Process according to Claim 1, characterized in that the optical waveguides (3) are introduced at the factory.

3. Process according to Claim 1, characterized in that the optical waveguides (3) are blown into the already laid tube (8).

4. Process according to Claim 1, characterized in that the optical waveguides (3) are jetted into the already laid tube (8) with the aid of a liquid medium.

5. Process according to one of the preceding claims, characterized in that the laying channel (19) is milled in a supporting laying (47) of the underlying laying surface (17), in particular a carriageway, using a milling wheel (15) which is arranged in the laying unit, and in cleaned, preferably using compressed air.

6. Process according to Claim 5, characterized in that the laying channel (19) is cut to a depth of from 50 to 100 mm, preferably 70 mm.

7. Process for introducing an optical cable, consisting of a tube and optical waveguides introduced therein, in supply lines in a solid underlying laying surface with the aid of a laying unit, characterized in that, as optical cable, a microcable or minicable (1) with an external diameter of the tube (8) of 2.0 to 10 mm, preferably of 3.5 to 5.5 mm, is pressed into utility lines (31) for sewerage, gas or water, which have been left open, using a laying unit.

8. Process for introducing an optical cable, composed of a tube and optical waveguides, introduced therein, into supply lines in a solid underlying laying surface with the aid of a laying unit, characterized in that, as optical cable, a microcable or minicable (1) with an external diameter of the tube (8) of 2.0 to 10 mm, preferably of 3.5 to 5.5 mm, is inserted into existing, active utility lines (35) for sewerage, gas or water, using a laying unit.

9. Process according to one of Claims 1 to 4, characterized in that the microcable or minicable (1) is pressed into the solid ground (17) by means of a laying unit.

10. Process according to one of Claims 1 to 4, characterized in that the microcable or minicable (1) is jetted into the solid ground (17) by means of a laying unit.

11. Process according to Claim 1, characterized in that the microcable or minicable (1) is introduced into the laying channel (19) with a feed element in the form of a laying blade (18), in that the filling material (20) is filled in using the filling device in the form of a filling-in lance (16), and in that the laying channel (19) is topped off at the road surface with a sealing layer (50).

12. Process according to Claim 11, characterized in that a curable filling foam is introduced, as filling material (20) into the laying channel (19).

13. Process according to Claim 11 or 12, characterized in that the laying channel (19) is filled with a bitumen sealing compound or a preformed bitumen joint filler.

14. Process according to one of Claims 11 to 13, characterized in that the laying channel (19) is marked by a light-reflecting layer (64), preferably with embedded glass bodies (65) as filling means.

15. Process according to one of the preceding claims, characterized in that the microcable or minicable (1) is drawn off from a ring wound up on a laying reel (24) and, prior to the introduction into the laying channel (19), is aligned and levelled parallel to the route of the laying channel (19) with the aid of guide rollers (25).

16. Process according to one of the preceding claims, characterized in that in the case of changes in direction and bends up to minimum radii of 30 mm of the laying channel (19), the microcable or minicable (1) is adapted to the directional route in a bending apparatus (61).

17. Process according to one of the preceding claims, characterized in that the tube (8) of the microcable or minicable (1) is lengthened, if required, via connecting elements which are known per se, for example sleeves, crimpable tubes or fittings.

18. Process according to one of Claims 1 to 16, characterized in that the tube (8) of the microcable or minicable (1) is lengthened, if required, with the aid of adhesive connections, solder connections or weld connections which are known per se.

19. Process according to one of the preceding claims, characterized in that excess lengths of the microcable or minicable (1) in the form of equalizing loops (66) are laid in the cable-laying route.

20. Process according to Claim 11, characterized in that the laying channel (19) is arranged in the side of the roadway, in the cycle path or footpath, on or in kerbstones or along the fronts of houses.

21. Process according to one of Claims 1 to 5 or 11 to 20, characterized in that holding-down elements (52, 57) are pressed into the laying channel (19) after the introduction of microcable or minicable (1).

22. Process according to Claim 21, characterized in that U-shaped, spreadable clamps (52) are pressed into the laying channel (19).

23. Process according to Claim 21, characterized in that rivet-like metal bolts (57) are pressed into the laying channel (19).

24. Process according to one of the preceding claims, characterized in that use is made of a microcable or minicable (1) with a tube (8) consisting of chromium-nickel-molybdenum (CrNiMo188).

25. Process according to one of Claims 1 to 23, characterized in that use is made of a microcable or minicable with a tube consisting of aluminium.

26. Process according to one of Claims 1 to 23, characterized in that use is made of a microcable or minicable with a tube (8) consisting of steel.

27. Process according to one of Claims 1 to 23, characterized in that use is made of a microcable or minicable with a tube (8) consisting of plastic.

28. Process according to Claim 27, characterized in that reinforcement elements, preferably glass fibres, carbon fibres or a sintered carbon-fibre structure, are embedded in the plastic.

29. Process according to one of the preceding claims, characterized in that connecting sleeves and/or branching sleeves (68) are arranged in the cable-laying route, and in that the microcables or minicables (1) are guided in tightly through inlets and outlets (70).

30. Process according to Claim 11, characterized in that the microcable or minicable (1) is provided with an expandable cable sheath.

31. Process according to Claim 11, characterized in that excess lengths of the microcable or minicable (1) in the form of U-shaped bends are laid in the cable-laying route.

32. Process according to one of the preceding claims, characterized in that discharge means or feed means of the minicable or microcable (1) are run as an overhead cables or a non-supported cable.

33. Process according to one of Claims 1 to 23, characterized in that use is made of a microcable or minicable with a tube (8) consisting of copper.

34. Process according to one of the preceding claims, characterized in that minishafts for receiving cable sleeves are arranged in the cable-laying route.

35. Process according to one of the preceding claims, characterized in that the tubes (8) of the minicable or microcable (1) are provided with an inner coating of friction-reducing plastic, preferably PTFE.

36. Process according to Claim 35,

characterized in that the inner coating is separated out from an emulsion, preferably with the action of heat.

37. Process according to one of the preceding claims, characterized in that, for the minicable, use is made of a tube with an internal diameter of more than 1.8 mm.

38. Process according to one of the preceding claims, characterized in that, for the minicable, use is made of a tube with a wall thickness of from 0.2 to 0.4 mm.

39. Process according to one of the preceding claims, characterized in that, for minicables, use is made of tubes whose wall thickness to external diameter ratio is between 1/5 to 1/20, preferably 1/10.

40. Process according to one of the preceding claims, characterized in that a laying channel is cut by means of a laying unit whose cutting-wheel arrangement is varied in terms of thickness such that the width of the laying channel is adapted in one cutting operation to the corresponding diameter of the microcable or minicable used.

41. Process according to Claim 40, characterized in that the cutting-wheel arrangement, comprising two blades (TS1, TS2) and a spacer ring located therebetween, is drawn onto the axle of the laying unit, the thickness of the the spacer ring determining the overall thickness of the cutting-wheel arrangement for the necessary width of the laying channel.

42. Process according to one of Claims 40 or 41, characterized in that use is made of a spacer ring which has circumferential cutouts or profiles, by way of which the laying channel is simultaneously cleaned of cutting residues during the cutting operation.

43. Process according to Claim 42, characterized in that the laying channel is cleaned by way of rectangular cutouts on the circumference of the spacer ring.

44. Process according to Claim 42, characterized in that the laying channel is cleaned by way of sawtooth-shaped cutouts on the circumference of the spacer ring.

45. Process according to Claim 42, characterized in that the laying channel is cleaned by way of bar-like, flexible brushes (B) on the circumference of the spacer ring (DR).

46. Laying unit for producing a laying channel for receiving a minicable or microcable, characterized in that it contains a cutting-wheel arrangement on whose drive axle (AS) there is arranged two blades (TS1, TS2) and, located therebetween, a spacer ring (DR) adapted to the necessary overall thickness.

47. Laying unit according to Claim 46,

characterized in that the spacer ring (DR) has rectangular cutouts (RA) on the circumference.

48. Laying unit according to Claim 46, characterized in that the spacer ring (DR) has sawtooth-shaped cutouts (SA) on the circumference.

49. Laying unit according to Claim 46, characterized in that the spacer ring (DR) has bar-like, flexible brushes (B) on the circumference.

50. Laying unit according to one of Claims 46 to 49, characterized in that it is also possible for a material such as bitumen to be broken out by way of the cutouts of the blades TS1.

51. Laying unit according to one of Claims 46 to 49, characterized in that the cutouts of the blades (TS) are provided with hard-metal teeth (Z) which can be exchanged if required.

52. Laying unit according to Claim 51, characterized in that the hard-metal teeth (Z) are arranged in a staggered manner.

53. Process according to one of the preceding claims, characterized in that a tension-resistant release element (ZT, FP) for lifting the laid minicable or microcable (MK) is introduced, when said cable is laid in the laying channel (VN), above the minicable or microcable (MK) in the filling material (FM) of the laying channel (VN), in that the tension-resistant release element (ZT, FP) is then drawn out during the lifting operation, in which case the laying

channel (VN) is also released of filling material (FM), and in that the minicable or microcable (MK) is then removed from the laying channel (VN).

54. Process according to Claim 53, characterized in that a line (ZT) is laid as tension-resistant release element.

55. Process according to Claim 53, characterized in that a metal profile, preferably consisting of steel, is laid as tension-resistant release element (ZT).

56. Process according to one of Claims 53 or 55, characterized in that the tension-resistant release element (ZT) is laid in strip form.

57. Process according to Claim 53, characterized in that the release element (ZT), initially adhering to the minicable or microcable (MK), is laid in one operation, and in that the release element (ZT) is ripped away from the minicable or microcable during the lifting operation, and in that the filling material (FM) is removed from the laying channel (VN) together with the ripped-away release element (ZT).

58. Process according to Claim 53, characterized in that the laying channel (VN) is covered by a filling profile (FP), preferably consisting of rubber or plastic, which can be used as release means and is preferably introduced into the laying channel (VN) with bitumen, in that, during the lifting operation, the filling profile is first of all removed and the minicable or microcable (MK) is then lifted.

59. Process according to one of Claims 53 to 58,

characterized in that a release means which prevents wetting is introduced between the minicable or microcable (MK) in order to keep as low as possible the adherence to the minicable or microcable (MK) of the filling material (FM) introduced into the laying channel.

60. Process according to one of Claims 53 to 57, characterized in that the tension-resistant release element (ZT) consisting of metal is used for the power supply along the route of the microcable.

61. Process according to one of the preceding claims, characterized in that the metallic tubes of microcables or minicables (MK, MK1, MK2) are connected to the central power supply.

62. Process according to Claim 61, characterized in that the electric through-connection between two microcables or minicables (MK1, MK2) is effected via a metallic cable sleeve (KM).

63. Process according to one of Claims 61 to 62, characterized in that the power is supplied via a minicable or microcable (MK) and an additionally laid power cable (SK, RL, ZS).

64. Process according to one of Claims 61 to 63, characterized in that the microcable or minicable (MK, MK1, MK2) is laid, without insulation, as a return conductor.

65. Process according to one of Claims 61 to 63, characterized in that

the minicable or microcable (MK) is provided with an insulation (IS) and is laid, with insulation, as a supply conductor, and a separate earth conductor is laid, without insulation, as a return conductor (RL, NH).

66. Process according to one of Claims 61 to 65, characterized in that a cable holding-down device (NH) introduced in the laying channel (VN) is used as current conductor.

67. Process according to Claim 61, characterized in that a minicable or microcable (MK) in a common insulation (IS) is laid in the laying channel (VN) as power supply conductor.

68. Process according to Claim 67, characterized in that the insulated minicable or microcable (MK) and the insulated additional conductor (ZS) are connected to one another via a web (ST).

69. Process according to Claim 61, characterized in that two insulated minicables or microcables (MK1, MK2) are introduced in the laying channel (VN), the power being supplied via one cable and the power being returned via the second cable.

70. Process according to Claim 61, characterized in that two insulated minicables or microcables (MK1, MK2) are combined in an insulation (IS) and are introduced into the laying channel (VN).

71. Process according to one of the preceding claims,

characterized in that the route of the optical minicable or microcable (MK) laid in a laying channel (VN) is followed with the aid of a detector (D).

72. Process according to Claim 71, characterized in that, as detector (D), use is made of the metal detector which is known per se.

73. Process according to Claim 71, characterized in that, as detector (D), use is made of a georadar-like unit.

74. Process according to Claim 71, characterized in that, when the minicable or microcable (MK) is laid, magnets (M) whose magnetic fields are located with the aid of the detector (D) are introduced into the laying channel (VN).

75. Process according to Claim 74, characterized in that the magnets (M) are arranged on individual, spaced-apart cable holding-down devices (NH).

76. Process according to Claim 74, characterized in that bar-like, magnetic cable holding-down devices (SNHM) are introduced, at distances apart from one another, in the laying channel (VN).

77. Process according to Claim 76,

characterized in that the bar-like magnetic cable holding-down devices (SNHM) are arranged on longitudinally running support filaments (TF), such that they adhere to said filaments, and are introduced into the laying channel (VN) as continuous, grid-like cable holding-down devices (GNH).

78. Process according to Claim 77, characterized in that the bar-like magnetic cable holding-down devices (SNHM) have their ends clamped onto the support filaments (TF).

79. Process according to Claim 76, characterized in that the bar-like magnetic cable holding-down devices (SNHM) have their ends (E) fitted into a longitudinally running support sheet (TFOL).

80. Process according to Claim 74, characterized in that U-shaped, magnetic cable holding-down devices (NHM) are clamped into the laying channel (VN).

81. Process according to one of Claims 74 to 80, characterized in that the magnets of the cable holding-down devices (M, SNHM, KNHM) are introduced with alternate polarity (S, N) into the laying channel (VN), such that a magnetic coding is obtained for the laid minicable or microcable (MK), and that this coding for the laid minicable or microcable (MK) is thus evaluated with the aid of the detector (D).

82. Process according to Claim 71, characterized in that the filling material of the laying channel (VN) is provided with metallic fillers.

83. Process according to Claim 71,

characterized in that electronic components such as pulse generators (I) are installed in the cable holding-down devices (NH) for active cable detection.

84. Process according to Claim 71, characterized in that it is possible to connect to the microcable (MK) freely programmable chips (C) which can give information on the condition and laying of the microcables (MK) and may also be reprogrammed subsequently.

85. Process according to one of Claims 71 to 84, characterized in that interrogation and programming are effected from the outside via induction loops (IS).

86. Process according to Claim 84, characterized in that the power supply and interrogation of the chips (C, CH) are effected from the sleeve (M).

87. Process according to Claim 86, characterized in that the chip (CH) is accommodated in a sleeve (M) which is easily accessible and is controlled electrically from the outside.

88. Process according to Claim 1, characterized in that, for subsequently repairing a microcable with the aid of a unit (GF) for exposing the microcable (MK), the filling material (FM) is removed from the laying channel (VN) over a length which is required for the introduction of a repair set, said repair set being formed from two cable sleeves (KM), two equalizing loops (AS) and a connecting tube (VR)

between the cable sleeves (KM), in that the microcable (MK) is lifted out of the laying channel (FVN) freed of the filling material (FM), in that the tube of the microcable (MK) is shortened over a length which corresponds to the repair set, and in that the repair set is connected tightly to the two ends of the microcable (MK).

89. Process according to Claim 88, characterized in that the filling material (FM) is removed by cutting taking place in the laying channel (VN).

90. Process according to Claim 88, characterized in that the filling material (FM) is removed with the aid of a heatable cutter (SCH), by means of which the filling material (FM), preferably bitumen, is first of all heated and then cut out.

91. Process according to one of Claims 88 to 90, characterized in that, tangentially to the exposed laying channel (FVN), two core holes (B) are drilled, at a distance from one another, vertically into the ground (VG), in that a cable sleeve (KM) which is suitable for the connection of microcables (MK) is introduced into each core hole (B), a connecting tube (VR) which belongs to the repair set being introduced between the two cable sleeves (KM) in the exposed laying channel (FVN), and in that the ends of the microcable (MK) which is to be repaired are connected tightly to tubular equalizing loops (AS) which are arranged at the off cable-sleeve inlets (KE).

92. Process according to Claim 91,

characterized in that the microcables (MK) are connected tightly to the equalizing loops (AS) by being crimped thereon (AK).

93. Process according to one of Claims 88 to 92, characterized in that use is made of a measuring device (MV), preferably an electric continuity tester, which indicates that, upon exposure of the laying channel (VN), contact is made with the microcable (MK), and in that a lifting device (F) for the cutting wheel or the cutter (SCH) is thus set in motion.

94. Process according to Claim 88, characterized in that the filling material (FM), at least the residue of the filling material (RFM), is removed from the laying channel (VN) with the aid of a ripping wire laid along the microcable (MK).

95. Process according to one of Claims 88 to 93, characterized in that the tube of a microcable (MK) is provided with a barely adhering insulation (IS), for example consisting of polyethylene, paper or a swelling nonwoven, which is slit open after the removal of the filling material (FM), with the result that the microcable (MK) can be easily removed from the exposed laying channel (FVN) without adhering to the residual filling material (RFM).

96. Process according to Claim 88, characterized in that the filling material (FM) is drawn out with the aid of cable holding-down devices which run along above the microcable (MK) in the laying channel (VN) and may be heated strongly as current-carrying conductors.

97. Process according to one of Claims 88 to 96, characterized in that

the filling material (FM) is removed in layers.

98. Process according to one of Claims 88 to 97, characterized in that the filling material (FM) is removed from laying channels which run between individual slabs of a concrete roadway.

99. Process according to one of Claims 88 to 97, characterized in that the filling material (FM) is removed from laying channels which are arranged as expansion joints in concrete slabs of a roadway, in which case, at transitions from one concrete slab to the other, the microcable runs in core holes which are likewise filled with filling material.

100. Process according to one of Claims 88 to 99, characterized in that the cable sheath is thickened or the microcable has applied over it a foam-rubber element (GU) which is laid continuously in the longitudinal direction, protects the cable against mechanical damage and forms a release means between the cable and bitumen.

101. Process according to one of the preceding claims, characterized in that the microcable (MK) is fixed in a laying channel (VN) in the ground (VG) with the aid of a continuous profile body (GU, GUR, VP, NFT) consisting of elastic material, and in that the laying channel (VG) is sealed by introducing a sealant (B, BVP).

102. Process according to Claim 101, characterized in that bitumen is used as the sealant (B, BVP).

103. Process according to Claim 101, characterized in that

a hot-melt adhesive, preferably consisting of polyamide, is used as the sealant (B, BVP).

104. Process according to one of Claims 101 to 103, characterized in that use is made of a profile body (GU) with circular cross-section.

105. Process according to one of Claims 101 to 103, characterized in that use is made of a profile body (GUR) with annular cross-section.

106. Process according to one of Claims 101 to 105, characterized in that use is made of a profile body (VP) which is adapted to the laying channel (VN) and has a longitudinally running duct for microcables (MK).

107. Process according to Claim 106, characterized in that use is made of a profile body (VP) with a plurality of free ducts (FK) running in parallel.

108. Process according to Claim 106 or 107, characterized in that optical waveguides are introduced into the free ducts (FK).

109. Process according to one of Claims 101 to 108, characterized in that use is made of a profile body (VP) with barbs (WH) integrally formed laterally thereon.

110. Process according to one of Claims 101 to 109,

characterized in that, as the profile body, use is made of a grooved moulding (NFT) which comprises an elastic profile (P) which is coated with sealant (BVP) and has free ducts (FK).

111. Process according to one of Claims 101 to 110, characterized in that the sealant (B, BVP) is softened by the supply of heat, in particular by infrared radiation (IS), before being pressed into the laying channel (VN).

112. Process according to one of Claims 101 to 111, characterized in that the laying of the microcable (MK) followed by the laying of the profile body (GU, GUR, NFT) in the laying channel (VN) and the sealing of the laying channel (VN) by means of a sealant (B, BVP) are effected with the aid of a combined laying machine (VW), which carries along a drum for microcable (TMK) and a drum for profile body (TGU).

113. Process according to one of Claims 101 to 112, characterized in that an additional profile (ZP) is introduced on a profile body (GU, GUR, VP, NFT) which has already been introduced.

114. Process according to one of the preceding claims, characterized in that, after, or simultaneously with, the introduction of the minicable or microcable (MK) into a laying channel (VN), an elastic, notch-impact-resistant covering profile (AP) which is difficult to cut through from the outside by mechanical intervention is laid in the longitudinal direction of the minicable or microcable (MK), and in that the width of the laying channel (VN) is covered in so doing.

115. Process according to Claim 114, characterized in that a covering profile (AP) comprising a metal wire or a plastic, hemp or sisal line is laid in the laying channel (VN).

116. Process according to Claim 114, characterized in that a covering profile (AP) with a core (MFK) which is difficult to cut through mechanically and an elastic sheathing (APU) consisting of plastic material, preferably of foam, is introduced, the core (MFK) comprising one or more metal wires or one or more plastic, hemp or sisal filaments.

117. Process according to Claim 116, characterized in that use is made of a covering profile (AP) in which the core (MFK) is formed by stranded filaments.

118. Process according to one of the preceding claims, characterized in that an intermediate covering (ZWA) is introduced between the minicable or microcable (MK) and the covering profile (AP).

119. Process according to Claim 118, characterized in that use is made of an intermediate covering (ZWA) with inserts (ZWE), preferably comprising metallic wires.

120. Process according to one of Claims 118 or 119, characterized in that use is made of an intermediate covering (ZWA) with sensors introduced therein.

121. Process according to one of the preceding claims, characterized in that use is made of a minicable or microcable (MK) with a tube (MKR) consisting of plastic.

122. Process according to one of the preceding claims, characterized in that electrically conductive metal lines (ZWE) are arranged in the covering profile (AP) or in the intermediate covering (ZWA) for locating the cable-laying route.